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Product Quality and Safety

# Changes in the chemical composition of some pieces of pork stored at different temperatures

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***Abstract.*** *The paper includes changes that occur in vacuum packed pieces of meat obtained by removing the haunch, vacuum packed and kept in a chamber at different temperature conditions of 4ºC. and 6ºC. The changes that occur during storage were examined at 2, 3 and 5 days after production. It was found that during the storage of meat cuts, there are significant changes to reduce water content, while protein, fat and mineral substances are increasing. The total number of bacteria in meat cuts during storage is increased in those who are kept at a temperature of 6ºC. During storage of meat cuts from production to 3 days best sensory characteristics of meat cuts have that meat cut that has been stored at 4ºC.*

**Keywords:** booth, *M. Semitendinosus*, pork meat, meat quality

## Introduction

Packaging of meat and meat has a social and health importance. It protects the organoleptic, physicochemical and microbiological properties of these products from internal and external influences over the manipulation of the producer to the consumer (Dzhinleski, 1985).Nowadays, meat and meat products must be healthy and attractively packaged, because consumer demands are constantly growing (Phillips, 1996; Philips, 2001) as an outcome the requirements that meet producers must accomplish and packing material also constantly grow (McMilin et al., 1999; Dragoev 2004; Antoniewski et al., 2007). Parallel with the attention that the modern consumer has paid to the quality of meat also grows the importance of packaging. Packaging is the most dynamic area of industry for meat. Sometimes whole bodies were preparing in warehouses of retail facilities where they were cut and removed in primary cuts of meat, stored in a cool, and cutting and packaging for presentation is conducted as needed. Today this practice is very rare. The present trend in packaging technology will allow these operations to be removed from trade and returned to manufacturing plants. But it will not happen at once but in stages depending on local conditions.

Packaging of fresh meat into wholesale cuts and its distribution at the point of sale are developed together with the centralization of cutting and removing of the corpses in the halls of removing. This tradition has evolved especially with the appearance of the packaging of fresh meat in vacuum. It first started in the United States. In Europe vacuum packaging has a significant progress only in Britain, Ireland and France than in Germany, Italy and Spain. In Republic of Macedonia packaging of fresh meat (vacuum packaging) began to apply from 1990 so that today many assortments of products of fresh meat are packaged in a vacuum. Packaging in vacuum slows down the oxidation processes, the growth of aerobic bacteria, weight loss, and color changing, and is used for magnification and achieving maturation of fresh meat.

The objective of this research is to investigate the chemical and microbiological changes that occur during storage at temperatures between 4 and 6°C and how they affect the sensory characteristics of vacuum-packed pieces of fresh pork.

## Material and methods

Anatomic topographic features (*Musculus Semitendinosus*) for this test is used poly hamstring muscle of the thigh of local breed of white pigs. *M. Semitendinosus* is poly hamstring muscle, lying caudally of the two-headed muscle and makes the caudal edge of the trunk. This muscle starts with two heads-disc starting from the last named and the first tail vertebrae and pan head that starts from the big bumps on the sitting bone.

The mass of the pigs before scattering and after previous was around 100 pounds. From the cooled half-backs the thigh with knee is separated by a cut which goes between the last flank and the first vertebra and then separates the abdominal wall close to the thigh. The knee-joint diverges from the thigh with a cut which passes through the joint wrist. Then it's done removing the adipose tissue of the thigh with a knife and removing the thigh. After removing the thigh, polyhamstring muscle is separated from other muscles of the thigh after a natural connection. By cooling the pieces of meat, concerning an achieving medium temperatures of 4ºC are vacuum packed in foil vacuum type Vebomatic. After vacuuming from the same meat randomly are taken 12 packages that are divided into two groups, the first group was kept in a refrigerator at a temperature 4ºC and the second group of sausage is stored at a temperature of 6ºC.

Meat cuts that are subject to examination are marked and all are measured at 2, 3 and 5 days of electronic scales Bizerba mark at the nearest point of 0.1g. The measurement was carried out in order to

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send the change of the mass of meat slices or shrinkage during storage, although they are packed in vacuum foil. On the 2 and 5 day test was conducted on the chemical composition, sensor analysis and microbiological analysis on the change and development in microorganism in meat cuts during storage. A 5 day is carried out only chemical analysis of meat cuts.

Chemical tests are performed on the standard recognized methods used for scientific purposes. Water content in the pieces of meat was investigated by drying in a temperature of 105°C during 24 hours, or until reaching the same table in two consecutive measurements. The content of fat in meat cuts is investigated by the standard method of extraction with organic solvent (Wochs et al., 1961), proteins were examined by the method of Kjeldahl. The content of mineral substances is melt by combustion in muffle oven temperature of 550°C (Pozarskaja et al., 1964). pH value of meat is measured by pH-meter German manufacturing type Lu-co. Sensory analysis was performed using the 9 - level scale developed by the Higher Institute for Local Prudence in Moscow (VNIIMP) with 10 trained analyzers. Sensory analysis was conducted in the appearance, colour, consistency, smell and taste. Each sensor feature analyzers have the opportunity to assess a rating from 1 to 9 where 1 and 9 indicates undesirable desirable. Microbiological tests were performed according to usual practice that apply in the local industry by seeding the aqueous solution from the taken test of the nutritious ground and of the incubation temperature of 30°C during 72 hours.

The results obtained on the examinations are processed according to standard methods used for scientific purposes by using a standard computer program ANOVA MS Exel program 1997-2003 in accordance to established statistical methods (Statistica vol. 6 Stat Soft 2003).

## Results and discussion

The results of changes in chemical composition of meat cuts that are kept at a temperature of 4°C are given in Table 1. As seen from the presented data in average water content at the beginning of the trial, regarding the 2 days after production is 74,0%, protein 20,5%, 4,5% fat and mineral substances 1%. On the 3rd day of storage at a temperature of 4°C a change in weight of meat and chemical composition, although water content is reduced and the meat was 73,88%, while the fat and protein has increased which is 4,52% and 20,58% and mineral substances are increased from 1 to 1,02%. The 5$^{th}$ day after manufacture chemical composition of meat cuts is changing because the water content had dropped to 73,82%, the masses increase to 4,54%, 20,60% of protein and mineral substances of 1,04%. The 5$^{th}$ day of keeping the water content is reduced in relation to the second day to 0,12 %, while fat increased and its increase in relation to the beginning of 0,02 % and protein are increased in relation to the beginning for 0,08%, the content of mineral substances in relation to initially increase by 0,02 %.

The results of changes in chemical composition of meat cuts that are kept at a temperature of 6°C are given in Table 2. As seen

**Table 1.** Dynamics in changing the chemical composition of *Musculus Semitendinosus* during storage at a temperature of 4°C

| Indicator | Chemical composition 2,3,and 5 day | | |
|---|---|---|---|
| | 2<br>Mean ± SD | 3<br>Mean ± SD | 5<br>Mean ± SD |
| Weight, % | 100<br>Mean ± SD | 97.52<br>Mean ± SD | 93.28<br>Mean ± SD |
| Water,% | 74.00 ± 0.012 | 73.88 ± 0.010 | 73.82 ± 0.014 |
| Fat,% | 4.5 ± 0.028 | 4.52 ± 0.014 | 4.54 ± 0.012 |
| Protein | 20.5 ± 0.010 | 20.58 ± 0.014 | 20.60 ± 0.011 |
| Mineral substances ,% | 1.0 ± 0.022 | 1.02 ± 0.011 | 1.04 ± 0.018 |
| pH | 6.14 | | |

**Table 2.** Dynamics in changing the chemical composition of sirloin during storage at a temperature of 6°C

| Indicator | Chemical composition 2,3,and 5 day | | |
|---|---|---|---|
| | 2<br>Mean ± SD | 3<br>Mean ± SD | 5<br>Mean ± SD |
| Weight,%<br>Mean ± SD | 100<br>Mean ± SD | 98.80<br>Mean ± SD | 97.78<br>Mean ± SD |
| Water,% | 74.00 ± 0.018 | 73.85 ± 0.010 | 73.80 ± 0.040 |
| Fat,% | 4.5 ± 0.032 | 4.54 ± 0.040 | 4.56 ± 0.021 |
| Protein | 20.5 ± 0.021 | 20.59 ± 0.022 | 20.61 ± 0.011 |
| Mineral substances ,% | 1.0 ± 0.021 | 1.02 ± 0.012 | 1.05 ± 0.014 |
| pH | 6.18 | | |

**Table 3.** Analise variance chemical structure in pices of meat kept on 4ºC and 6ºC

| Source of Variation | SS | df | MS | F | P-value |
|---|---|---|---|---|---|
| Between Groups | 17010.16 | 3 | 5670.053 | 2545478 | 124*ns |
| Within Groups | 0.03564 | 16 | 0.002228 | | |
| Total | 17010.19 | 19 | | | |

Legends: SS- Sum of squares, df-Degree of freedom, V- Varianc, *ns-Non significant

from the presented data pieces of meat on the 3rd day of storage temperature of 6°C was changed on less and it is reduced, and 98,80%, water content is 73,85%, fat content is slightly increased and amounted to 4,54%, protein 20,59% and 1,02% mineral matter. On the 5th day of storage of meat pieces of a change in reducing lowering the mass of meat cuts, which reduced to 97,78% on the second day, the water is reduced to 73,80%, fat are elevated at 4,56%, 20,61% of protein and mineral substances of 1,05%. On 5th day of keeping pieces of meat at the temperature of 6°C water content decreased compared to the second day of 0,15 %, while fat increased and amounted to 0,04%, protein grew at 0,09% and mineral matter of 0,02%. The differences that exist in the chemical composition in the pieces of meat are insignificant kept on 4º – 6ºC but they still exist. During the keeping by reducing the mater content adequately is increasing the total content of dry substances (proteins, fats, minerals). That increasing at the dry substances isn't proportional at all three components, it shows smaller or bigger variability. The biggest increase on the 2nd, 3rd and 5th day is found in fats in the meat witch is kept on 6ºC. In the meat that is kept on 4ºC there is constant and standard of fat content and proteins. The differences between fats and proteins are statistical not important. The differences that exist in the chemical structure in pieces of meat kept on 4ºC and 6ºC aren't statistical significant, p>0,05 (Table 3).

The dynamics of change of waters content in the meat kept on 4ºC and 6ºC, we can see on the graphic picture in Figure 1. During the keeping there are some changes of microorganisms in the meat, and that change is under influence from reducing of mater and than increase concentration of dry substances, especially the salt and than comes change of pH. As result of that change in chemical structure in the pieces of meal which is set in during the keeping, comes to changes in microbiological pictures pieces of meat that are kept on temperature 6ºC. There is significant increasing in the number of bacterius contrasting with the pieces of meat kept on 4ºC.

In the pieces of meat kept on 6ºC, on the fifth day from the producing the total number of bacterius were 80, but in the pieces of meat kept on 4ºC the total numbers of bacterius were 50 (Figure 2). The increasing number of bacteria's in the pieces of meat that are kept on 6ºC, it's because of the better conditions their evolution.

Results got from sensory testing of the pieces of meat that are kept on 4ºC and 6ºC shows that there are differences. Pieces of meat kept on 4ºC, after 5 days had sensory characteristics, which best can be seen from Figure 3, where analysis on the and 5th day are minimal. The differences in sensory characteristics of the meat kept on 6ºC for five days, are showing big differences, which can be best seen on (Figure 3). Pieces of meat kept on 6ºC for 5 days had significant bad sensory characteristics which are around 1/3 from

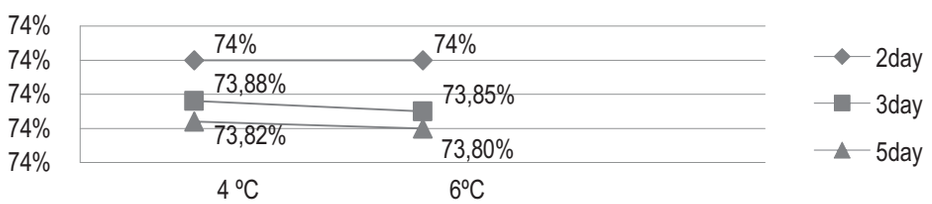


**Figure 1.** Water content in *M. Semitendinosus* kept at a temperature of 4ºC and 6ºC to 5 days

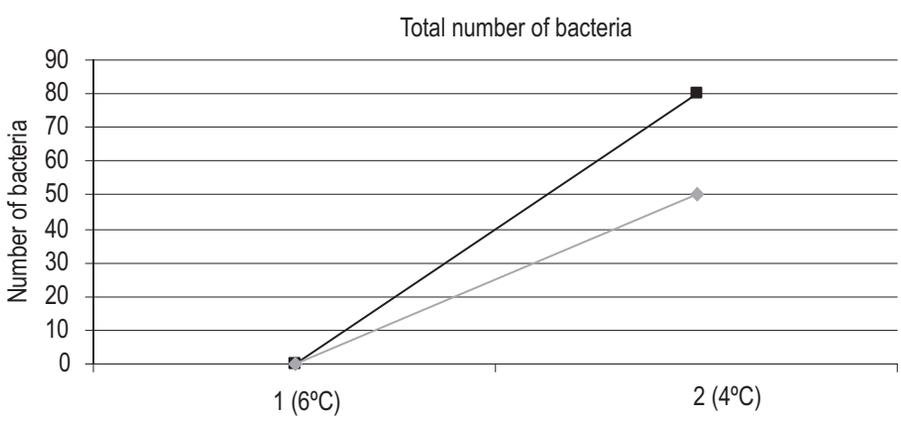


**Figure 2.** The total number of bacteria in vacuum *M. Semitendinosus* kept at a temperature +4 and +6 º C at 2 and 5 day production

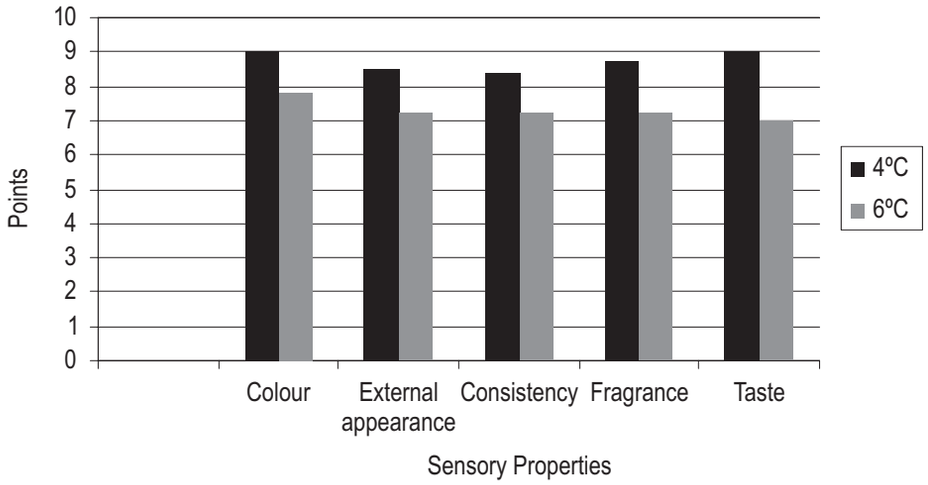


**Figure 3.** Sensory characteristic of pieces of meat kept on 4ºC and 6ºC on the fifth day at the producing.

that they had on the 2nd day from the producing.

Many authors have examined the impact of sustainability on the vacuum packaging of meat (Djinleski, 1985; Robertson, 1993; Bell et al., 1994; Kleittner, 2004; Stamenkovic et al., 2007) examined the viability of vacuum packed meat pieces of different temperature cooling and found that the meat cuts that have been kept lower temperature had on good sensory characteristics of meat cuts that have been kept at relative lyhigher temperatures. Examinations carried out by us in accordance with the tests they have conducted other.

## Conclusion

During the keeping of meat on 4ºC and 6ºC quantity of mater is reducing in both tests. Differences in reducing are statistically not significant. With mater content reducing the percent of dry substances grows. The biggest growth is found in fats, then come proteins and it's smallest in minerals. In pieces of meat kept on 6ºC, the total number of microorganism on the 5th day is significant bigger and it is 80, and those kept on 4ºC their number is 50 in 1g. Sensory characteristic in pieces of meat tested on 2nd and 5th day after their production are changed. The biggest changes are found in meat kept on 6ºC, and minimal are in those kept on 4ºC between 2nd and 5th day.

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